ject does not admit of a brief abstract.—Another valuable paper on this subject, by Du Bois-Reymond himself, is commenced in this part. It constitutes the second part of his researches on negative variation of the muscular current during contraction, and must be consulted by all workers in this difficult branch of research.—Dr. Wenzel Grüber has five papers, some of considerable length, on various anomalous muscular dispositions. Such papers should be condensed as much as possible.

THE two last numbers of the *Nuovo Giornale Botanico Italiano* are chiefly occupied with Italian botany.—Among papers of more general interest we have a description by A. Mori, of the structure of the wood of *Periploca græca;* and two by Prof. Caruel:—On the flowers of *Ceratophyllum*, in which he describes the peculiar contrivance for the fertilisation of the female flowers, the rigid leaves apparently serving as the channel of transport for the pollen; and observations on *Cynomorium*, in which several points in the structure of the flower are detailed, and the author gives his adhesion to Dr. Hooker's suggestion of a possible genetic connection between Balanophoreæ and Halorageæ.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, March 15.—The first article is by Prof. Tomaschek, of Brünn, on mean temperatures as thermal constants for vegetation. The law, formerly pointed out by him, of the dependence of the commencement of blooming, on the height of daily mean temperatures, appears not only not to be shaken, but to be supported by an investigation of the results for the exceptional year 1862.—The next article is by Dr. Hann, on the results of observations on Mount Washington and Pike's Peak. During very cold weather, the change of temperature with height is less than usual, amounting only to about 0·3° C. for each 100 metres, so that the equilibrium of the air vertically must be at such times very stable. The mean decrease with height in the dry climate of Pike's Peak is somewhat greater than in the Alps and at Mount Washington. The daily and monthly ranges are excessive on the elevated plains. Dr. Hann greatly regrets the impracticable form in which the reports have been published, considering the desirability of having the actual observations for Pike's Peak and Colorado Springs, two stations better situated for meteorological purposes than any others in the world, accompanied by the proper data and corrections, which are here wanting.—In the Kleinere Mittheilungen we find a description of Redier's self-registering barometer.

Journal de Physique, February.—This number commences with the first part of a paper by M. Jamin, describing his recent researches on magnetism. He gives an account of his methods of observation, offers some theoretical ideas on the nature of magnetism, and discusses magnetic conductivity and distribution in a thin plate.—In a note on meteorology applied to agriculture, M. Marié Davy gives some interesting tables with reference to changes observed in wheat at different dates (the relation of transpired water to the temperature and actinometric degree, the weight of constituent substances, proportion of nitrogen in stalk, &c.). He considers that by the end of May or beginning of June, according to locality, one may generally deduce from meteorological data the probable value of the coming harvest, save in the case of exceptional perturbations, whose injurious action is circumscribed.—M. Duter investigates the distribution of magnetism in circular and elliptical steel plates.

Gazzetta Chimica Italiana, 1876, fascicolo ii.—This part commences with a paper by G. Pisati in continuation of former researches entitled:—On the elasticity of metals at different temperatures. In this paper the author treats of the elasticity of torsion at various temperatures of wires of silver, iron, steel, copper, brass, gold, platinum, and aluminium. The apparatus employed is figured, and the results shown in many cases graphically by means of curves.—On the production of ozone during the evaporation of water, by G. Bellucci.—The modifications of starch in plants, by M. Mercadante.—Synthesis of propyl-isopropyl-benzene, preliminary note by E. Paterno and P. Spica. This hydrocarbon, of which the formula would be $C_6H_4 \left\{ \begin{matrix} C_3H_7 \\ CH_2.C_2H_5 \end{matrix} \right.$ has been prepared by the action of zinc ethyl on cumene chloride. It is a liquid a little lighter than water boiling at about 205°—208°. Other hydrocarbons boiling at a high temperature are also produced during the reaction. The authors propose to continue their researches.—The absence of leucine in the product of the germination of graminaceæ, by M. Mercadante.—The remainder of the part is devoted to abstracts of papers from foreign sources.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 15.—"Researches illustrative of the Physico-Chemical Theory of Fermentation, and of the conditions favouring Archebiosis in previously Boiled Fluids." By H. Charlton Bastian, M.A., M.D., F.R.S., Professor of Pathological Anatomy in University College, London, and Physician to University College Hospital.

The author first calls attention to the fact that no previous investigator has professed to have seen well-marked fermentation set up in urine that had been boiled for a few minutes, if it has thereafter been guarded from contamination. The previous invariable barrenness of this fluid after boiling has been ascribed by germ-theorists to the fact that any organisms or germs of organisms which it may have contained were killed by raising it to the temperature of 212° F. (100° C.).

In executing some of the experiments with urine described in this communication, two chemical agents have been brought into operation under novel conditions, and an ordinary physical influence has been employed to an entirely new extent. In several respects, therefore, these new experiments differ much, as regards the conditions made use of, from those hitherto devised for throwing light upon the much-vexed questions as to the possible origin of Fermentations independently of living organisms or germs, and as to the present occurrence or non-occurrence of Archebiosis.

The chemical agents employed under new conditions in these experiments were *liquor potassæ* and *oxygen*—both of them being well known as stimulants, if not as promoters, of many fermentative processes.

It has been recognised by several investigators of late years that neutral or slightly alkaline organic fluids are rather more prone to undergo fermentation than slightly acid fluids. This fact may be easily demonstrated. As the author pointed out in 1870, if two portions of an acid infusion are exposed side by side at a temperature of 77° F. (25° C.) fermentation may be made to appear earlier and to make more rapid progress in either of them by the simple addition of a few drops of liquor potassæ; on the other hand, if a neutral infusion be taken and similarly divided into two portions placed under the same conditions, fermentation may be retarded, or rendered slower in either of them at will, by the simple addition to it of a few drops of acetic or some other acid.

A neutral or faintly alkaline organic solution can in this way be demonstrated to possess a higher degree of fermentability than an otherwise similar acid organic solution. It seems, therefore, obvious that the changes capable of taking place in *boiled* acid and neutral solutions respectively should also vary considerably. Numerous experiments by different observers have demonstrated the correctness of this inference. Boiled acid infusions guarded from contamination mostly remain pure and barren if kept at temperatures below 77° F. (25° C.), though other infusions similarly treated and similar in themselves, except that they have been rendered neutral by an alkali, will oftentimes become corrupt and swarm with organisms. The latter result follows still more frequently with neutral infusions when they are exposed to a higher generating temperature in the warm-air chamber; and under this stronger stimulus a small number of boiled acid fluids will also ferment.

On the other hand, the influence of oxygen in promoting fermentation has been fully appreciated since the early part of the present century. Formerly an influence was assigned to it as an initiater of fermentation as all-important as some chemists assign to living germs at the present day. But this was a very exaggerated view. In some fluids, as the author has shown, fermentation may be initiated just as freely, or even rather more so, in closed vessels from which the air has been expelled by boiling, as in others in which atmospheric air, and consequently oxygen, is present. The explanation of this fact is probably to be found in the supposition that, in starting the fermentation of these fluids, diminution of pressure may be of as much, or even of more importance than contact with free oxygen. In respect to other organic fluids, however, the influence of oxygen seems decidedly more potent as a co-initiater of fermentation than that diminution of pressure which is brought about by hermetically sealing the vessel before the fluid within has ceased to boil. Urine will be found to be an example of this latter class of fluids.

The physical influence which has been employed in unusual intensity in the present researches is *heat*.

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Previous experimenters have never designedly had recourse to a generating or developing temperature above 100° F. (38° C.). The heat employed has frequently been below 77° F. (25° C.), though a temperature between this and 95° F. (35° C.) has been regarded both by chemists and biologists as most favourable to the occurrence and progress of fermentative changes generally.

Early in the month of August, 1875, the author ascertained the fact that some boiled fluids which remained barren when kept at a temperature of 77°–86° F. (25°–30° C.) would rapidly become turbid and swarm with organisms if maintained at a temperature of 115° F. (46° C.). More recently he has discovered the surprising fact that a generating temperature as high as 122° F. (50° C.) may be had recourse to with advantage in dealing with some fermentable solutions. Fluids which would otherwise have remained barren and free from all signs of fermentation have, under the influence of this high temperature, rapidly become turbid and corrupt. This discovery is regarded as of great importance in reference to the questions now under discussion, and it is one which was quite unexpected. The author had previously shared in the generally received opinion that temperatures above 100° F. (38° C.) were likely to impede rather than promote fermentation.

In maintaining the experimental fluids at the high temperature above-named, the vessels containing them were placed in the hot-air chamber of an incubator, such as physiologists employ, to which one of the very ingenious gas-regulators of Mr. F. S. Page had been fitted (see *Journal of the Chemical Society*, January, 1876). In this way the fluids may be kept at a known and practically constant temperature for an indefinite time.

Liquor Potassæ as a Promoter of Fermentation in Boiled Urine.

In the autumn of 1875 the author instituted some experiments to ascertain whether the fermentability of boiled urine, like that of many other fluids, could be increased by previously mixing with it a quantity of liquor potassæ sufficient for its neutralization.

The experiments answered this question in the affirmative. It was found that urine to which the above-named amount of liquor potassæ had been added, would constantly ferment and swarm with organisms within a few days after it had been boiled; though some of the same stock of urine in the acid state (that is, without the addition of any alkali) would when similarly treated in other respects, remain barren. The fact of the production of an increased fermentability in boiled urine by previous neutralisation was thus established.

Further experiments were then instituted to throw light upon the cause of such increased fermentability. It was desirable to ascertain whether (1) it was due to survival of germs in the boiled neutralised fluid, or (2) to the chemical influence of potash in initiating or helping to initiate the molecular changes leading to fermentation in a fluid devoid of germs or other living matter.

The mode of testing the relative validity of these rival interpretations seemed easy. It was only necessary to ascertain what the effect would be of adding boiled liquor potassæ, in proper quantity, after the acid urine had been rendered barren by boiling it instead of adding it previous to the process of ebullition. If fermentation occurred in the fluid thus neutralised without extraneous contamination, the first interpretation would obviously be negatived.

This crucial experiment was at first tried with flasks plugged with cotton-wool, the plug in each of them being penetrated by a closed glass tube containing the measured amount of liquor potassæ. The tubes having been drawn out to a capillary portion at the lower end, and bent at an obtuse angle, they could be easily broken by slight downward pressure against the bottom of the flask whenever it was desired to mix the liquor potassæ with the boiled urine. This apparatus was very similar to that first made use of by Dr. William Roberts in some experiments with hay-infusion (Phil. Trans. vol. clxiv. p. 474), in which he obtained opposite results from those now about to be recorded with urine. The latter fluid is, however, for several reasons more suitable than hay-infusion for trying such experiments.

Several trials made with urine in this apparatus showed that its fermentability was just as much increased by adding boiled liquor potassæ after the urine had been boiled in the acid state, as by adding the alkali previous to the process of ebullition. Such a result was therefore quite opposed to the first interpretation as to the cause of the increased fermentability of neutralised urine.

The definite overthrow or establishment of this interpretation was so important that it seemed desirable to try such experiments again by some more rigid and certain method. The author, therefore, devised a new mode of experimentation in which sealed retorts replaced the flasks plugged with cotton-wool, and in which the contents of the enclosed liquor-potassæ tubes could be more effectually heated.

It was first of all ascertained that accurately-neutralised urine boiled in a retort and sealed whilst boiling, would ferment in a day or two if kept at a temperature of 122° F.[1]

This fact having been established, other retorts were charged with a measured amount of urine, and also with a small glass tube containing liquor potassæ in quantity almost sufficient to neutralise the urine employed.[2] The glass tubes containing the liquor potassæ had been drawn out at one end, sealed, and then immersed in boiling water for different periods before introducing them into the retorts. After each retort had been charged with urine and a liquor potassæ tube, its neck was drawn out to a capillary point, the urine was boiled, and the retort was hermetically sealed before ebullition had ceased. Thus closed, the vessel was at once immersed with its neck downwards in a can of boiling water for from four to fifteen minutes, so as to expose it and its contents for an additional period to a temperature of 212° F. (100° C.).

The urine was thus boiled in its unaltered acid state and sterilised. After the retorts had cooled the liquor potassæ was liberated from its tube in all but one of the batch, which was kept as a control experiment. The liberation was easily effected. It was only necessary to give the retort a sudden shake so as to drive the capillary neck of the enclosed tube against its side. The tube was thus broken and immediately (owing to the comparative vacuum within the retort) the liquor potassæ was sucked out and mixed with the fluid which it was destined to neutralise.

The result of these experiments was similar to those executed with the plugged flasks and liquor-potassæ tubes. The boiled caustic potash added afterwards within the sealed retorts, caused the previously barren fluids to ferment and swarm with *Bacteria*. The fluid in the control experiment remained pure, though after several days, or longer, it also could be made to ferment by breaking the liquor-potassæ tube, and replacing the retort in the warm chamber.

Effects of liberating Oxygen by Electrolysis within the Closed Retorts.—A few other experiments were made with retorts to which platinum electrodes had been fitted. These contained, as before, measured amounts of urine, together with liquor potassæ tubes. All the preliminary stages were similar to those of the experiments above recorded; but just before breaking the liquor-potassæ tubes in these further experiments, oxygen and hydrogen were liberated from the boiled urine by electrolysis.

The result in the few experiments made was very remarkable. Under the combined influence of liquor potassæ, oxygen, and the high temperature of 122° F. (50° C.), the sterilised urine fermented and swarmed with *Bacteria* within the closed retorts in from 7–12 hours—that is, in a much shorter time than would suffice for the occurrence of similar changes in unboiled urine freely exposed to the air.

Behaviour of some specimens of unaltered Acid Urine under the influence of the High Generating Temperature of 122° F. (50° C.).

In the course of the previous experiments it was found that occasionally a specimen of boiled urine would ferment at a temperature of 122° F. without the addition of liquor potassæ. This was afterwards ascertained to occur invariably (with the urine experimented upon) when the acidity of the fluid was not higher than would be represented by six minims of liquor potassæ to the ounce (or about 1½ per cent.). Urines slightly more acid than this sometimes did and sometimes did not ferment without liquor potassæ; but when the acidity exceeded what would be equivalent to two per cent. of liquor potassæ, the fluid did not ferment under the influence of the high generating temperature alone. Urines of all degrees of acidity, however, were found to ferment under the combined influence of heat and liquor potassæ added afterwards, in the manner already detailed.[3]

[1] Though the boiled urine will ferment in retorts from which the air has been expelled by boiling, it will undergo this change more quickly if it is in the presence of purified or sterilised air. In the experiments now about to be described, however, it was much more convenient to use airless retorts.

[2] As a slight excess in the amount of liquor potassæ has been proved to have a most restrictive influence when dealing with urine, it was found safer in these experiments not to provide liquor potassæ sufficient for full neutralization. Many details on this subject are given in the memoir itself.

[3] In the urine of highest acidity with which experiment has been made, twenty minims of liquor potassæ to the fluid ounce (about 4 per cent.) was required for neutralisation.

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It was further ascertained that the acidity of some specimens of urine was lessened during the process of ebullition (owing to the deposition of acid phosphates); and such urines boiled for six minutes were found to ferment in a much shorter time than when they were only boiled for three minutes. The prolongation to this extent of the germ-destroying temperature actually hastened the subsequent process of fermentation.

Interpretation of Results.

The generally received belief that all *Bacteria* and their germs are killed by exposing them even for a minute or two to the temperature of 212° F. (100° C.) has of late been strongly reinforced by Prof. Tyndall. The fact, therefore, of the fermentation of some specimens of boiled acid urine, with the appearance of swarms of *Bacteria*, under the influence of the high generating temperature of 122° F. (50° C), is inexplicable except upon the supposition that fermentation has in these instances been initiated without the aid of living germs, and that the organisms first appearing in such fluids have been evolved therein.

If the author's further position (Proceedings of Royal Society, Nos. 143 and 145, 1873), that *Bacteria* and their germs are killed in fluids whether acid or alkaline at a temperature of 158° F. (70° C.), is correct, then the occurrence of fermentation in the previously neutralised boiled urine would similarly disprove the exclusive germ-theory of fermentation and establish the occurrence of Archebiosis.

Any difficulty which might have been felt by others in accepting the above interpretation of the results of these latter experiments—in face of the view held by M. Pasteur that some *Bacteria* germs are able in neutral fluids to survive an exposure to a heat of 212° F. (100° C.)—has been fairly met and nullified by the experiments (devised for the purpose), in which the urine was boiled in the acid state and subsequently fertilised by the addition of boiled liquor potassæ.

If we look at these latter experiments from an independent point of view, it will be found that this fertilisation of a previously barren fluid by boiled liquor potassæ must be explained by one or other of three hypotheses:—

1st Hypothesis. The boiled liquor potassæ may act as a fertilising agent because it contains living germs.—However improbable this hypothesis may seem on the face of it, it has been actually disproved by many of the experiments recorded in this memoir. These experiments show that boiled liquor potassæ will only act as a fertilising agent when it is added in certain proportions. If it acted as a mere germ-containing medium, a single drop of it would suffice to infect many ounces, a gallon, or more of the sterilised fluid. This, however, is never the case; it only fertilises the barren urine when it is added in a proportion dependent upon the precise acidity and quantity of the fluid with which experiment is being made.

2nd Hypothesis. The fertilising agent may act by reviving germs hitherto presumed to have been killed in the boiled acid urine.—The acceptance of this hypothesis would involve a general recantation of the previously received conclusion that *Bacteria* and their germs are killed by boiling them in acid fluids. But such a recantation would be scarcely justifiable or acceptable unless based upon good independent evidence.

The possibility, however, of accepting this second hypothesis is still further closed by the results of experiments in which a slight excess of liquor potassæ was added to the boiled urine. Such fluids invariably remained barren. Yet it can be easily shown that the mere development and growth of *Bacteria*-germs may take place both quickly and freely in boiled urine containing a very large excess of liquor potassæ.[1] It would seem that this agent mixed with boiled urine in quantity slightly more than is needed for neutralisation, prevents the *origination* of living matter therein, although even when in considerable excess the same agent affords no obstacle to the development, growth, and multiplication of germs purposely added thereto.

In the face of these facts it would seem impossible to accept this second hypothesis, even if it had not been independently negatived by the great mass of evidence—lately reinforced by the experiments of Prof. Tyndall—to the effect that *Bacteria* and their germs are really killed in fluids raised for a few minutes to the boiling-point (212° F.).

3rd Hypothesis. The fertilising agent acts by helping to initiate chemical changes of a fermentative character in a fluid devoid of living organisms or living germs.—If the cause of the fermentation of the fluids in question does not exist in the form of living organisms or germs either in the fertilising agent itself or in the medium fertilised, then it must be found in some chemical reactions set up between the boiled liquor potassæ and the boiled urine.

The experiments in which liquor potassæ is added to urine in definite proportions before and after it has been boiled with the result of inducing fermentation in the otherwise barren fluids, as well as those in which unaltered urine ferments under the influence of the high generating temperature of 122° F. (50° C.), all alike, therefore, point to the same conclusion. They show, as other experiments have done, that an exclusive germ-theory of fermentation is untenable; and they further show that living matter may and does originate independently during the progress of fermentation in previously germless fluids.

As a result of the fermentative changes taking place in boiled urine or other complex organic solutions, many new chemical compounds are produced. Gases are given off, or these with other soluble products mix imperceptibly with the changing and quickening mother-liquid, in all parts of which certain insoluble products also make their appearance. Such insoluble products reveal themselves to us as specks of protoplasm, that is of "living" matter. They gradually emerge into the region of the visible, and speedily assume the well-known forms of one or other variety of *Bacteria*.

These insoluble particles would thus in their own persons serve to bridge the narrow gulf between certain kinds of "living" and of "dead" matter, and thereby afford a long-sought-for illustration of the transition from chemical to so-called "vital" combinations.

[1] A mixture of one part of liquor potassæ to seven of boiled urine poured into a bottle which has been washed with ordinary tap-water will, within forty-eight hours, swarm with *Bacteria* if it is kept at a temperature of 122° F.

Zoological Society, June 20.—Prof. Flower, F.R.S., vice-president, in the chair.—The Secretary exhibited a drawing of a fine species of Fruit-Pigeon of the genus *Carphopoga*, living in the Society's Gardens, which apparently belonged to *C. paulina*, Bp. of Celebes and the Sulu Islands.—Mr. Sclater read extracts from letters received from Signor L. M. D'Albertis and Dr. George Bennett, respecting M. D'Albertis' proposed new expedition up the Fly River, New Guinea, and exhibited a small collection of bird skins made at Yule Island and on the adjoining coast of New Guinea, by the last-named naturalist.—Dr. A. Günther, F.R.S., read a letter from Commander W. E. Cookson, R.N., respecting the large tortoises obtained in the Galapagos Islands which had been recently deposited in the Society's Gardens by Commander Cookson. The living specimens had been obtained in Albemarle Island, those obtained in Abingdon Island having died before reaching this country. Dr. Günther added some remarks on the specimens of tortoises and other animals collected by Commander Cookson, and promised a more detailed account on a future occasion.—Mr. G. E. Dobson read a paper on peculiar structures in the feet of certain species of mammals by which they are enabled to walk on smooth perpendicular surfaces, especially alluding to *Hyrax* and the bats of the genus *Thyroptera*.—A communication was read from Dr. J. S. Bowerbank, F.R.S., being the sixth part of his monograph of the silicio-fibrous sponges.—A communication was read from the Rev. O. P. Cambridge containing a catalogue of a collection of spiders made in Egypt, with descriptions of new species and characters of a new genus.—A communication was read from Mr. W. T. Blanford containing remarks on the views of A. von Pelzeln as to the connection of the faunas of India and Africa, and on the mammalian fauna of Tibet.—A second communication from Mr. W. T. Blanford contained remarks on some of the specific identifications in Dr. Günther's second report on collections of Indian reptiles obtained by the British Museum.—Mr. Howard Saunders read a paper on the *Sterninæ* or Terns, with descriptions of three new species, which he proposed to call *Sterna tibetana*, *Sterna eurygnatha*, and *Gygis microrhyncha*.—Dr. Cunningham, of the University of Edinburgh, described a young specimen of a dolphin, caught off Great Grimsby, in September, 1875. After pointing out the great difficulty experienced in referring it to its proper place amongst the dolphins—this difficulty arising chiefly from the unsatisfactory and even unreliable descriptions which have been given in this country by former observers—he came to the conclusion that he was justified in referring it to *Delphinus albirostris*, the differences being, in his opinion, merely those of age.—Mr. J. W. Clark read some notes on a dolphin lately taken off the coast of Norfolk, which he was likewise induced to refer to the same species.—A

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communication was read from Mr. R. B. Sharpe, containing the description of an apparently new species of owl from the Solomon Islands, which he proposed to call *Ninox solomonis.*—Mr. A. H. Garrod some notes on the anatomy of certain parrots.—Mr. H. E. Dresser read the description of a new species of broad-billed sandpiper, from North-Eastern Asia, to which he gave the name *Limicola sibirica.*—A second communication from Mr. Dresser contained the description of a new species of *Tetraogallus*, discovered by Mr. Danford in the Cilician Taurus, which he proposed to call *T. tauricus.*—Dr. A. Günther read some notes on a small collection of animals brought by Lieut. L. Cameron, C.B., from Angola.—A communication was read from Lieut. R. Wardlaw Ramsay, giving the description of a fine new species of Nuthatch from Karen-nee, which he proposed to call *Sitta magna.*

Meteorological Society, June 21.—Mr. H. S. Eaton, M.A., president, in the chair. The following papers were read:—On the climate of Scarborough, by F. Shaw. The thermometers used were placed in a louvre-boarded case fixed to the north side of a wooden structure, having an open grass plot in front of them. The garden is about midway between the north and south sides of the town, and 150 yards from the shore; and as both residents and visitors are continually passing along this line, the observations may be taken as fairly representing the temperature of Scarborough as a watering-place. The mean monthly temperatures based on the average of the past eight years are:—

Jan., 38°·8	April, 46°·6	July, 60°·4	Oct., 48°·2
Feb., 39·7	May, 50·5	Aug., 58·9	Nov., 42·2
Mar., 41·6	June, 55·9	Sept., 55·1	Dec., 39·0

The mean for the year is 48°·1.

The maximum temperature on any day in July, the warmest month, does not exceed on the average, 78°·0; the highest in the eight years being 85°·5 in 1868. The mean of the extreme minimum temperature in the eight Januarys is 24°·2; the lowest being 13°·3, which occurred on January 1, 1875. The moderate and agreeable summer temperature is due to the close proximity of the town to the sea, which in the warmest month of the season is about 5° below that of the air. The autumn and winter temperatures are also much influenced by the sea on the one hand, and the shelter afforded by the surrounding hills on the other. The sea is about 5° warmer than the air in the autumn, and 3° in the winter, while the prevailing winds are south-westerly and not felt in their full force. The annual rainfall, on the average of the past ten years, is 28·29 inches, which falls on 167 days.—Notice of upward currents during the formation and passage of cumulus and cumulo-stratus clouds, by Rev. J. Crompton. On Nov. 1, 1866, the day after the visit of the Prince and Princess of Wales to Norwich, when the city was profusely decorated with flags, the author, when walking close to the cathedral, was struck with the unusual fluttering of the flags on the top of the spire, which is 300 feet high. They were streaming with a strained, quivering motion, perpendicularly upwards. A heavy cloud was passing overhead at the moment, and as it passed the flags followed the cloud and then gradually dropped into comparative quietness. The same phenomenon was noticed several times. As the cloud approached, the upper banners began to feel its influence, and streamed towards it against the direction of the wind, which still blew as before, steadily on all below; as the cloud came nearer the vehement quivering and straining motion of the flags increased, they began to take an upward perpendicular direction right into the cloud, and seemed almost tearing themselves from the staves to which they were fastened; again, as the cloud passed they followed it as they had previously streamed to meet its approach, and then dropped away as before, one or two actually folding over their staves. All the other flags at a lower elevation did not show the least symptom of disturbance.—Suggestions on certain variations, annual and diurnal, in the relation of the barometric gradient to the force of the wind, by Rev. W. Clement Ley. The author finds that the mean velocity of the wind corresponding to each gradient is much higher in summer than in winter. This is the case at all stations (though not equally) with all winds, with all lengths of values of radius of isobaric curvature, and with all values of actual barometric pressure. The general character of the mean diurnal variations of velocity, as these occur at the stations in the British Isles, may be fairly inferred from mean horary velocity curves, and may be thus described:—At the inland stations, in summer, a slight increment of velocity occurs about midnight. This is succeeded by the morning minimum, which takes place in most of the months examined a little after sunrise. The mean velocity then rises until 1 P.M., when the diurnal maximum is sometimes attained. A slight subsidence then commonly occurs, but the mean velocity rises again at 3 or 4 P.M., and this second increment frequently forms the diurnal maximum. A great fall then takes place, which is more rapid than the rise in the morning; and the evening minimum, which is in most months the diurnal minimum, is attained about 10 P.M. The mean velocity at 1 P.M. is, in fine and hot weather, more than double the 10 P.M. velocity in miles per hour, and exceeds the diurnal mean by about one-third. In winter the inflexions are very greatly modified. The midnight rise is not in all months traceable, and the subsequent diminution is not very great. The morning maximum occurs about sunrise. The diurnal maximum takes place about 1 P.M., is less than double the minimum in miles per hour, and exceeds the mean of the day by about one-fifth only.—Average weekly temperature of thirty years (1846–75) at Cardington, by John Maclaren.—De la vulgarisation par la presse des Observations météorologiques, by M. Harold Tarry.

Physical Society, June 10.—Prof. G. C. Foster, president, in the chair.—Mr. W. J. Wilson exhibited and explained a reflecting tangent galvanometer which he has recently designed for the purpose of exhibiting the indications of the instrument to an audience, and so arranged that the divisions on the scale show without calculation the relative strengths of different currents. It should be observed at the outset that this object cannot be attained by attaching a mirror to the needle as in the ordinary galvanometer, as the angle passed over by the reflected ray is double that through which the needle is deflected. In the arrangement exhibited, the beam of light after passing through a small orifice traversed by cross wires, is reflected vertically by a fixed mirror: the ray then passes through a lens, and is again reflected from a small plane mirror parallel to the first, which is rigidly fixed below a small magnetic needle. By this means the ray becomes again horizontal, and, since the light now falls on the second mirror always at the same angle, the extent of motion of the ray is identical with that of the needle, and, if the scale be one of equal parts placed in the magnetic meridian, the indications on it will be proportional to the tangents of the angles, and therefore to the strengths of the currents. The needle and mirror are suspended by a silk fibre, and a bent strip of aluminium, the ends of which dip into water in an annular trough, is attached to the needle in order to check its oscillations. A series of observations taken with varying resistances introduced into the current, showed that the indications are very reliable.—Mr. S. P. Thompson then exhibited an electromotor clock made by Mr. W. Hepworth, of York, and provided with a commutator of Mr. Thompson's design. This part of the instrument is very simple, and reverses the current at each single oscillation by means of two light springs resting on inclined planes. The motion of the pendulum drives the train of wheels by a modification of the gravity-escapement, and a very small battery-power is sufficient.—Prof. G. Fuller, C.E., exhibited and described his "electric multiplier," an instrument which may be looked upon as an automatic electrophorus. An insulated plate of vulcanite is supported in a vertical position, and on each side of it is an insulated metallic plate, and these can be moved together to and from the vulcanite by rotating a handle. When these plates are far apart, two metallic arms provided with points are made to pass one on each side of the vulcanite plates. One of these is insulated, and is provided with a rod terminating in a knob, which at a certain point in its path almost touches the metallic plate on the opposite side of the sheet of vulcanite. The other arm is in connection with the earth. The action of the instrument is as follows. A charge of, say, negative electricity, having been given to the insulated arm, it is passed over its face of the vulcanite, while positive is drawn up from the earth and thrown upon the opposite face by the uninsulated series of points. These arms are then removed, and the two metallic plates are brought into contact with the vulcanite. Call the side of the plate charged with negative electricity A, and the other B. The negative of A induces positive on the near face of its metallic plate and repels the negative. This passes, by a strip of tin-foil joining the two faces of the vulcanite, to the other metallic plate neutralising its free positive, and when the plates are moved away from the vulcanite, that from A is charged with positive, and that from B with negative. Before reaching its extreme position this latter

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communicates its charge to the insulated arm by the brass knob, and the electricity is then distributed over the face A. At the end of its path B is momentarily connected to earth. It will be evident that the effect of again bringing the plates in contact is to increase the charge of positive electricity on the metallic plate opposite the face A. With the small model exhibited, Prof. Fuller has frequently obtained sparks an inch in length.—Prof. Guthrie then exhibited and employed Prof. Mach's apparatus for sound reflexion, which is one of an interesting series of appliances designed by him for the demonstration of certain fundamental principles in physics. It consists of a mathematically exact elliptical tray, which is highly polished and provided with a close-fitting glass cover. The tray is covered with pulverised dry silicic acid, and a Leyden jar frequently discharged between two small knobs at one of the foci, when the silicic acid arranges itself in fine curves around the other focus.

Entomological Society, June 7.—Prof. Westwood, president, in the chair.—Messrs. A. A. Berens, A. H. Swinton, and C. M. Wakefield were elected ordinary members.—Mr. Douglas made some further remarks on the "Corozo Nuts," known as "Vegetable Ivory," exhibited by him at the last meeting, which were attacked by a beetle of the genus Caryoborus. Mr. McLachlan, in connection with the above, exhibited the nuts of a species of Caryoborus (*C. bactris*) forwarded to him by Prof. Dyer. In this case each nut served as food for a single larva only, which bored in it a cylindrical hole of considerable size and depth; whereas the former nuts were infested with several larvæ in each nut.—The President exhibited the larva of an Australian species of Hepialus, from Queensland, bearing a singular fungus, with four or five branches issuing from the back of the neck and the tail; also a fungus growing out of the back of a Noctua pupa.—Mr. McLachlan, on behalf of Dr. Atherstone of South Africa, exhibited a couple of very singular Orthopterous insects (belonging to the Acrydiidæ), which in colour and in the granulated texture so exactly mimicked the sand of the district as to render it almost impossible to detect them when at rest. The insect was supposed to approach the *Trachyptera scutellaris*, Walker.—The President read descriptions and exhibited drawings of two very singular forms of Coleoptera from Mr. A. R. Wallace's private collection. For the first, which belonged to the Telephoridæ, he proposed the generic name Astychina, remarkable for the form of the terminal joints of the antennæ in one sex, which were modified with what appeared to be a prehensile apparatus, differing from anything known in the insect world, but of which some analogous forms were found to occur among certain Entomostracous Crustacea. The other pertained to the Cleridæ, and was named Anisophyllus, differing from all known beetles by the extremely elongated branch of the ninth joint of the antennæ.—Mr. Smith read descriptions of new species of Hymenopterous insects from New Zealand, collected by Mr. C. M. Wakefield.—Mr. J. S. Baly communicated descriptions of new genera and species of Halticinæ.—Dr. Sharp communicated descriptions of a new genus and some new species of Staphylinidæ from Mexico and Central America, collected by Mr. Salvin, Mr. Flohr, and Mr. Belt.—Part I. of the Transactions for 1876 were on the table.

PARIS

Academy of Sciences, June 19.—Vice-Admiral Paris in the chair.—The following papers were read:—Theorems relative to curves of any order and class, in which are considered couples of rectilinear segments having a constant product, by M. Chasles. Experimental critique on glycémia (continued), by M. Cl. Bernard. He illustrates these three points:—1. Sugar is rapidly destroyed in the blood after its extraction from the vessels. 2. Within the vessels, after death, sugar disappears rapidly. 3. In the living animal, the saccharine richness of the blood oscillates constantly.—On the cause of the movements in Crookes's radiometer, by M. Govi. He rejects the idea of an impulsive force of light, and of thermal currents of gas in the receiver; the causes he assigns being the dilatation by heat, or condensation by cold, of gaseous layers which all bodies retain at their surface, even in an absolute vacuum. It should be possible to obtain insensible radiometers, by heating the vanes, during the action of the mercury pump. M. Fizeau said the constant motion, for as long as an hour, of a radiometer placed in the centre of a circle of candles, was against this hypothesis.—Examination of new methods proposed for finding the position of a ship at sea, by M. Ledieu.—On the existence of mercury in the Cevennes, by M. Leymerie. In 1843 he had evidence that liquid mercury had been met with near a village at the foot of the Jurassic plateau of Larzac, was injurious to vegetation, was used to cure sheep disease, &c.—The plague in 1876; prophylactic measures, by M. Tholozan.—M. Pasteur presented a work entitled "Studies on Beer: its Maladies, and their Causes; Process for rendering it Unalterable, with a New Theory of Fermentation."—Influence of temperature on magnetisation, by M. Gaugain. Allevard steel and Sheffield steel undergo nearly the same *permanent* modification when subjected to the same alternations of temperature, but the *temporary* modification is much greater for the Sheffield steel than for the other. The coercive force is diminished by variations of temperature. The inductive action on a bobbin diminishes when the temperature increases.—Extension of the principle of Carnot to electric phenomena; general differential equations of the equilibrium of the movement of any reversible electric system, by M. Lippmann.—Letter to M. Dumas on experiments on the use of sulphide of carbon and sulphocarbonates, by M. Delachanal.—A letter from MM. Weyprecht and Wilczek was read, explaining their project for scientific exploration of the arctic regions.—Differential electro-actinometer, by M. Egoroff. Two of Edmond Becquerel's actinometers are arranged one above another in a common box, so that the current of the one is neutralised by that of the other, and a mirror galvanometer is interposed in the circuit. Each actinometer is a parallelopipedal box of glass with two opposite sides of hardened caoutchouc, and slits with silver plates in them. The outer box has slits to correspond, the width of which can be varied. The absorbing body to be studied is placed between the light and the slit corresponding to one of the actinometers, and the galvanometer noted when one and when both of the actinometers are in action.—Researches on the commercial analysis of raw sugars, by MM. Riche and Bardy.—On a new class of colouring matters, by M. Lauth. The first source of these has been the aromatic diamines obtained in reducing the nitrated derivative of acetylic combination of organic bases.—On some derivatives of isoxylene, by M. Gundelach.—On the spirophore, an apparatus for recovery of the asphyxiated, especially for drowning persons and new-born infants, by M. Woillez. (We notice this elsewhere.)—Graphic study of movements of the brain, by M. Salatré. Into an orifice of the cranium is inserted a glass tube, with caoutchouc stopper above, traversed by a smaller glass tube, which is connected with a lever and drum arrangement (of the Marey type). Water is poured in till it reaches about the middle of the small tube; its oscillations (from the brain surface) affect the registering lever. Among other results, the respiratory oscillations, observed simultaneously in the brain and the vertebral column, are synchronous. Artificial respiration reverses the order of oscillations, the liquid rising in inspiration, falling in expiration. Attitudes have a great influence. In efforts of any kind the oscillations are much increased.—Contractile vacuoles in the vegetable kingdom, by M. Maupas. The contractile vacuole has been regarded as a characteristic of animality. But various recent facts are against this. M. Maupas describes contractile vacuoles he has found in macrospores of the algæ, *Microspora floccosa*, Thuret, and *Ulothrix variabilis*, Kützing (both in Algeria).—The mineral of nickel, in New Caledonia, or "Garnierite," by M. Garnier.—On nitrated alizarine, by M. Rosenstiehl.

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